ATTACHMENT 1

Battery Energy Storage Alternative

Load shifting battery energy storage can partially avoid transmission upgrades. However, it cannot fully mitigate transmission expansion to realize the NREL solar potentials on O'ahu. While batteries distributed throughout the grid can reduce curtailment of as-available generation, relieving thermal capacity overloads (on the sub-transmission system) will require the batteries to be located close to the overload or co-located with the PV facility.

Similar to daytime PV congestion, significant amounts of batteries (2,000 MW) as selected in the PSIP E3 plans, co-located with PV systems in the NREL high solar potential areas will encounter sub-transmission capacity issues. Using batteries to avoid thermal overloads means that the batteries must discharge daily to free battery capacity for the next day to store the excess PV generation that would otherwise overload a sub-transmission line.

For example, the dark brown area around the New Lualualei Substation in Figure N-49 has 200 MW of solar potential. Currently, the Kahe-Mikilua sub-transmission line runs through that area. Figure N-50 uses the following assumptions:

- System load profile with DR (Theme 1) on August 19, 2025 scaled downward to the expected proportionate load on the Kahe-Mikilua line.
- 200 MW of grid-scale PV scaled based on the PV profile from the E3 Plan, High DG-PV case without LNG on August 19, 2025.
- 130 MW 4-hour load shifting battery scaled based on the load shifting battery profile from the E3 Plan, High DG-PV case without LNG on August 19, 2025.
- The net load is the difference between the generation and load sources.

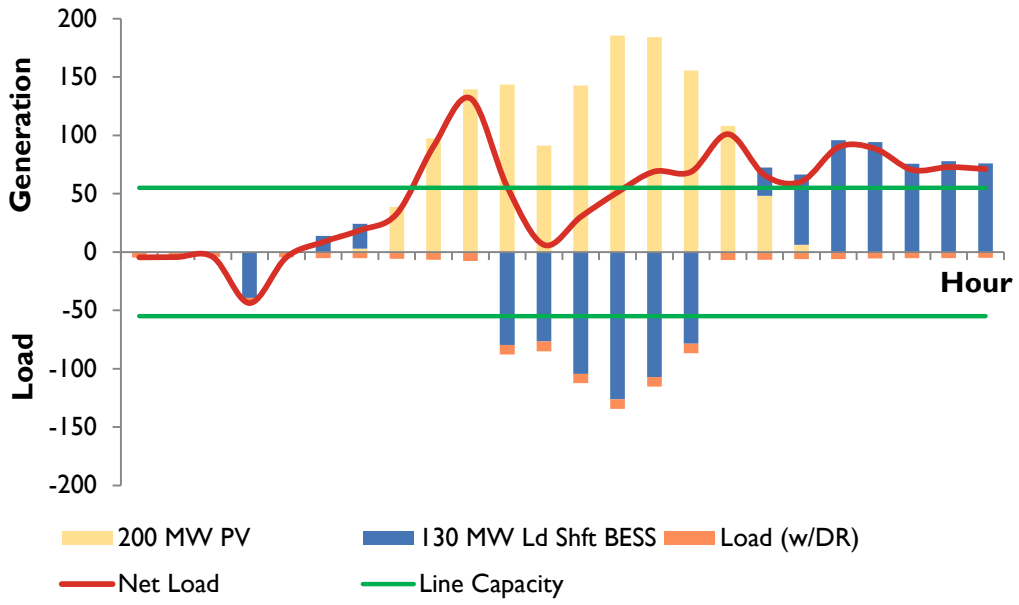

Figure N-1. Sub-Transmission Loading for a 200 MW PV + 130 MW BESS Project

Assuming the sub-transmission line is upgraded to the maximum 55 MVA capacity, Figure N-50 demonstrates that with a battery, capacity overloads can occur during PV and non-PV hours.

Figure N-51 illustrates the same scenario as Figure N-50, with the exception of a 105 MW grid-scale PV plant instead. In this case, the sub-transmission line generally has enough capacity to accommodate the PV output and battery discharge. However, to maximize the solar potential in this area, Hawaiian Electric would need to build a new sub-transmission or transmission line.

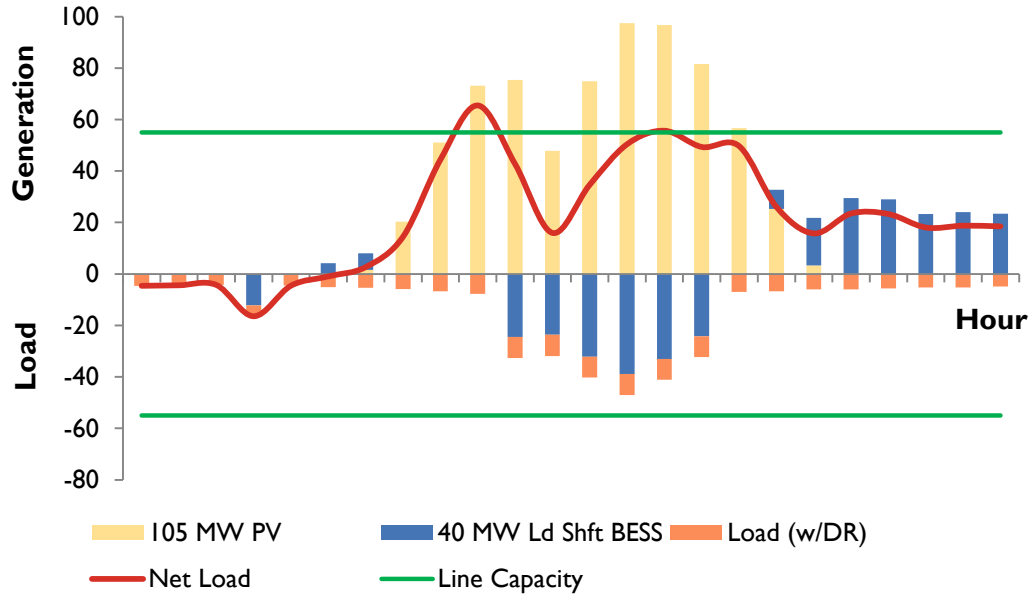

Figure N-2. Sub-Transmission Loading for a 105 MW PV + 40 MW BESS Project

Additional detailed analysis is required to assess other impacts as well as the feasibility and cost-effectiveness of battery storage to avoid transmission upgrades, which will depend on the location and capacity of the resources.